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Wildlife Tree Maintenance and Creation In Managed ESSF Forests in the Mackenzie District

R. Dawson, L. J. Murray and M. D. Wood
August 1992

PWFWCP Report No. 16

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INTRODUCTION

Wildlife trees or "snags" are an important component of forest communities. Many bird and mammal species including woodpeckers, many of the owls, and marten, are cavity-dependant, relying on snags for their very survival. Most of the cavity-dependant birds are insectivorous. There is evidence that these insect-eaters can reduce insect populations when they are at normal levels and help reduce the frequency of insect outbreaks (Savard 1990, Thomas et al, 1979). Other bird and mammal species use dead or dying trees for various functions including nesting, feeding, roosting, shelter and hunting posts.

In the Mackenzie area at least 22 species of wildlife are cavity dependant (Miller 1985), requiring cavities in trees in which to rear their young. Of these, half excavate their own cavities and are called "primary cavity nesters". Included in this group are the northern flicker, red-breasted sapsucker, red-breasted nuthatch and various species of woodpeckers and chickadees. The remainder are "secondary cavity nesters" such as owls, buffleheads, goldeneyes, tree swallows and marten which depend on natural cavities or cavities excavated by primary cavity nesters.

An additional 12 species of wildlife use tree cavities in which to rear their young when available (Miller 1985), but are not dependent on them. A variety of other species use snags for nesting, roosting, feeding and resting. Osprey often build their nests on the tops of broken snags (Campbell 1988). Flycatchers, bluebirds and hawks frequently hunt from snags or dead limbs of damaged trees (Miller & Miller 1980). Loose bark provides roosting areas for bats, and habitat for salamanders. Many birds forage for insects on decaying trees, while arboreal lichens produced on old trees provides food for caribou.

Because the secondary cavity nesters depend on natural cavities or cavities excavated by the primary cavity nesters, the requirements of all snag dependant species should be met by managing for the primary cavity nesters.

The use of snags by wildlife is affected by the successional stage of the surrounding vegetation community as well as the stage of deterioration of the snags themselves (Thomas et al 1979). Snags in recently logged areas may be suitable for flickers, but are not likely to be used by pileated woodpeckers, a species which prefers snags in mature forest settings. The species utilizing a snag will change as the snag deteriorates from a dying tree until its final collapse. In the early stages of decay, the snag is primarily used as a food source by woodpeckers and as perching sites for other birds. As the snag continues to decompose, cavity nesters can begin to use the snag, heartwood, holes, decay class

To maintain viable populations of snag dependant species, snags in various stages of decay must be available throughout the rotation. Live trees must be left to replace snags that fall, as snag life is relatively short. Recruitment of snags is essential if the needs of cavity dependant species are to be met over time.

The maintenance of snags has not been adequately addressed by forest management practices in the past. Existing snags are removed due to safety, fire and insect hazards, and to facilitate site preparation and stand tending after forest harvesting. They are also readily available and well used sources of firewood in areas near to population centres. The recruitment of future snags in new forest stands developed after logging is negated by forestry practises which remove all live trees from the site. Leaving some of these trees, sometimes called "green tree retention", would provide trees which would become the snags in the middle and latter stages of the stand rotation.

If viable populations of snag dependent species are to be maintained in managed forests, new forestry practises will have to be developed. These practises must ensure that sufficient numbers of wildlife trees of the varying sizes, species and distributions are present on managed forest lands throughout the rotation. A recent initiative of the Wildlife Tree Committee of B.C. (a multi-agency group represented by the Ministry of Forests, Ministry of Environment, Lands and Parks, Workers' Compensation Board and the Canadian Wildlife Service) has been the development and testing of the "Wildlife/Danger Tree Assessor's Course" designed to qualify assessors in identifying snags and danger trees from the perspectives of wildlife habitat and worker safety. A sub-committee of the W.T.C. is also investigating timber harvesting guidelines that will specifically recognize snag management as an integral part of maintaining biodiversity.

To date very little work, particularly in the northern half of the province, has been initiated to examine the relationship of forest management practises to the maintenance of suitable habitat for species requiring snags. The Ministry of Environment, and Pope and Talbot of Midway B.C., initiated a trial in 1989 to monitor the wildlife response to leaving 3m tall stubs during logging operations in the southern interior. Our project will implement and test a number of forest harvesting techniques specially designed to maintain wildlife tree habitats through time in managed forests.

OBJECTIVES

1) To test for differences in use by cavity nesters and by other breeding birds between conventionally clearcut blocks, old growth control areas and blocks cut with three modified techniques.

2) To test for differences in use by furbearers between conventionally clearcut blocks, old growth control areas and blocks cut with three modified techniques.

3) To document the deterioration of various species and sizes of snags over time.

4) To document the characteristics of nesting and feeding trees preferred by cavity nesters.

STUDY AREA

The study area is located in the Donna Creek drainage system south of the Wolverine Mtn. Range, approximately 80 kilometres NW of Mackenzie (figure 1). The study area can be reached by turning off Hwy 97 at Windy Point onto the Finlay Mainline. At the 96 km point, a left turn and 35 km. up the Finlay-Manson Mainline will lead to the Donna Creek Mainline. The study area is located 14 km up Donna Creek mainline.

The study area is situated in the moist very cold Engelmann Spruce-Subalpine Fir (ESSFmvS) biogeoclimatic subzone. This zone is characterized by an ericaceous shrub layer, a sparse cover of herbs, and a relatively dense moss layer (Ministry of Forests, 1991). Engelmann spruce and subalpine fir are the dominant climax tree species, with lodgepole pine the widespread serai species.

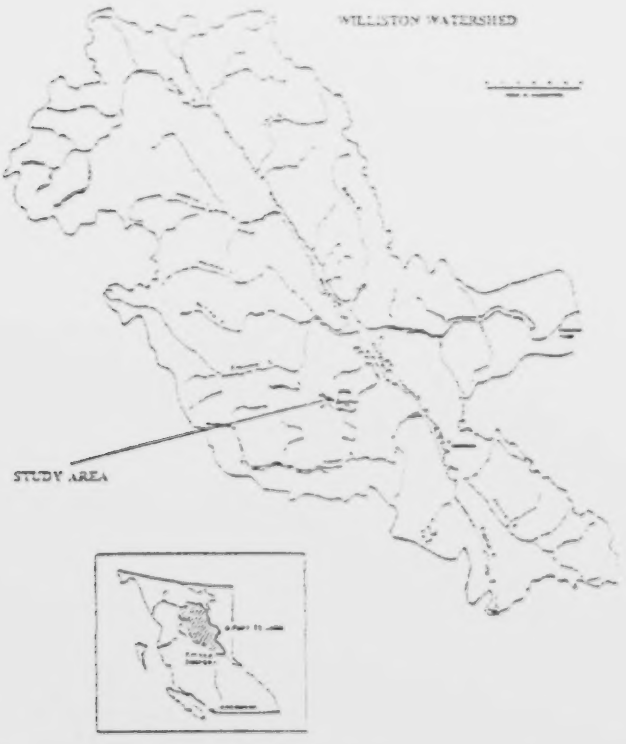

Figure 1. Map of study area in northern B.C.

METHODS

1. BLOCK DESCRIPTION AND LAYOUT

a) Cutblock Selection

Three cutblocks were selected in the ESSFmvS zone. Each of the three blocks are as similar as possible with respect to elevation, forest cover type, size, aspect, anticipated date of logging and anticipated site preparation and planting techniques as shown in Table 1. None of the blocks are scheduled to receive subsequent treatments that would endanger residual snags or clumps. The size of the cutblocks are representative of "normal" cutblocks in the area. Each individual cutblock is as uniform as possible with respect to slope, aspect and vegetation type at cutblock edge. Maps of the blocks are included in Appendix 1. All the blocks are accessible by road in summer, and reasonably close to roads kept open in winter. The blocks are within a three hour drive from Mackenzie, and are only about 45 minutes from Munro Logging Camp.

Table 1. Characteristics of experimental blocks.

BLOCK	1 (371-516)	2 (373-5546)	3 (373-5547)
SIZE (HA)	113	90.6	111.5
ELEVATION (M)	1080-1330 m	1000 - 1180 m	1010 - 1200 m
MAJOR TIMBER TYPES	BSw833, PlSw732, P1833, SwB834	BP1733, SwBP1834, PlSwB733	SwB844, SwB(P1)732 BSwP1844
ECOSYSTEM ASSOCIATIONS	ESSFmv3 01,03	ESSFmv3 01,05	ESSFmv3 01, 04, 05
SLOPE	20.8%	24.0%	13.0%
ASPECT	Southwest	Southwest	Southwest

b) Treatment and Control Areas

Three treatments and a conventionally logged control are included in the trial. The treatments were set up as a randomized complete block design with three replications. Each of the three blocks was divided into four sections with the three treatments and control assigned randomly in each block. Blocks 5546 and 5547 were logged between late September and early November 1991 using Koehring 618 and 628 feller bunchers with Koehring felling heads (20" and 22" respectively) and Quadco blades on both heads, and Clarke 667E wheeled grapple skidders. The ground was frozen at the time of logging and snow depths varied up to one metre. Block 516 will be logged in August 1992. All three blocks will be site prepared in late August/early September of 1992. In addition to the clearcut control, three adjacent tracts of old growth will also be used for comparative purposes.

Treatment 1 consisted of leaving 5 - 10 "short snags" or "stubs" per hectare of cutover (figure 2). These stubs were created by topping existing trees at a height of three metres with a feller buncher. The three meter height conforms with the maximum height allowed by the Worker's Compensation Board. Approximately one third of the stubs fell into each the following three classes: dead, dying and healthy green trees. Species included Engelmann spruce, lodgepole pine and subalpine fir. The stubs were evenly distributed throughout the treatment area. Any live healthy deciduous trees were left untouched where possible to reflect normal logging practices. The specifications called for at least half of the retained stubs to be greater than 30 cm d.b.h. with a component of larger stubs (greater than 50 cm dbh) where possible. No stubs less than 15 cm dbh were to be retained. When a residual snag less than 3 m is found during logging, it was left intact unless it was considered to be a hazard.

Treatment 2 consisted of retaining .25 hectare "clumps" or "islands" of standing timber at the frequency of one clump for each 8 hectares of treatment area (figure 2). Where necessary the clumps were situated to minimize the chances of blowdown. Otherwise the clumps were evenly distributed within the treatment area. For safety reasons, residual snags along the edge of the clumps were topped with a feller-buncher at 3 m. Some of the largest healthy trees near the perimeter were also topped at three metres to contour the edges of the clumps in an attempt to reduce blowdown. Treatment 3 is a combination of treatments 1 and 2 (figure 2).

A sample of stubs required in treatments 1 and 3 were marked with paint in each block to help the buncher operators visualize the 5 - 10 snags per hectare. The remainder of the snag selection was left to the feller-buncher operators trained in the selection criteria. The perimeters of the "islands" in treatments 2 and 3 were marked out prior to logging.

The clearcut "control" areas were logged according to current clearcutting practices. The old growth control areas were selected in the leave strips adjacent to the cutblocks. Few other suitable areas remain in this drainage area that are representative of the forest cover type in the area. Prior to winter furbearer monitoring scheduled to begin in November 1992, the boundaries and transects within the old growth, clearcut and treatment areas will be flagged.

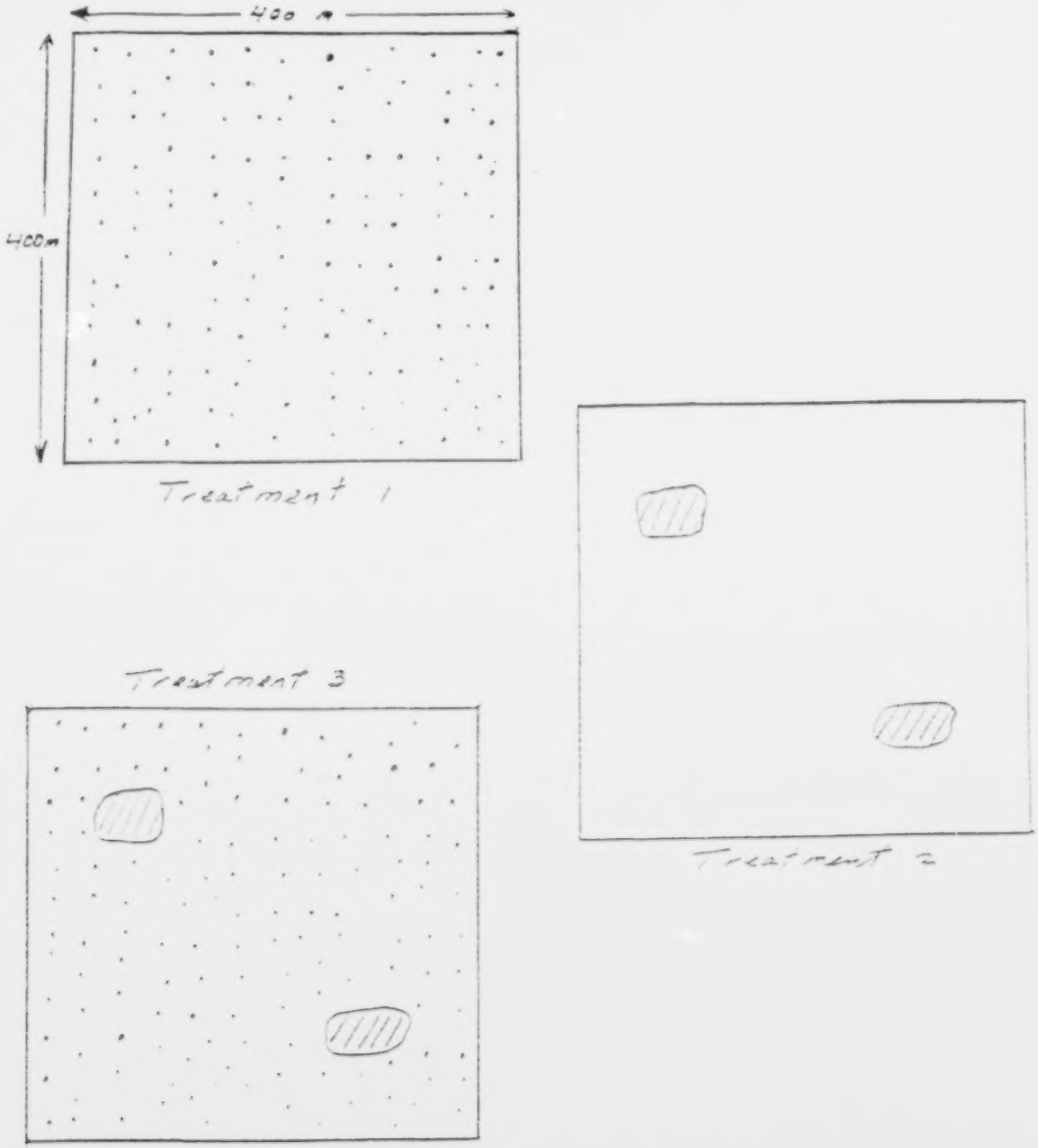

Fig 2. Schematic diagram of the three harvesting methods designed for maintaining wildlife trees. Treatment 1 leaves 8-10 three meter high stubs per hectare. Treatment 2 leaves a 1/4 ha. mixed age 'green tree' and snag retention clump for every 8 ha. Treatment 3 combines both of the other treatments.

2. DATA COLLECTION/MONITORING

Data will be collected on vegetation growth in the blocks, breeding bird use, winter furbearer use, snag deterioration, and cavity nester use of trees and nest tree characteristics. Data will be collected according to the schedule shown in Table 2. Although the schedule stops at 10 years, sampling should be carried out at least every 10 years thereafter until 50 years post-harvest.

a) Block Description

After logging, each block will be mapped at the 1:10,000 scale showing topographic contours and the location of treatments, green tree retention clumps, creeks, brush piles and any other features of possible significance to birds and small mammals. One of the blocks will be selected for detailed description. In this block four of the retention clumps will be described in terms of snags, live trees (standard timber cruise information) and vegetation.

b) Vegetation

Vegetation will be described using the standard methods from "Describing Ecosystems in the Field" except that the herb class will be separated into a low herb (0-30 cm) and a tall herb (31+ cm) class. In addition to vegetation descriptions in four "islands", forty-eight permanent sample plots will be located systematically along transect lines set up for breeding bird surveys and marked with painted angle iron posts. There will be four plots per treatment in each block for a total of 16 per block and 48 overall. A photo record will be established consisting of wide angle photographs taken in each of the four cardinal directions from the permanent plot centre at each plot.

c) Breeding Birds

Three sampling methods were considered (see Appendix 2 for a description and evaluation of methods) for measuring breeding bird density. The three methods included: point counts, spot mapping and transect counts. The transect method was chosen for its relative ease, flexibility and economic benefits.

The methods used will approximate those of Emlen (1971). Transects will be flagged in all blocks with 150m between adjacent lines. Sampling will cover the entire block including each treatment area. Expert observers will walk the transects four to five times during the breeding season (mid-May to early July) recording the location and perpendicular distance from the line to all birds observed. The estimate of the perpendicular distance from the transect to each bird at it's first point of detection is important in this method. The distance along the transect is also recorded so that each location can be accurately mapped. Any observed bird use of stubs will be recorded. After the transects have been surveyed a number of times, a

Table 2. Monitoring schedule for the first 10 years post harvesting. Numbers are manday estimates for each activity.

ACTIVITY/YEAR	1	2	3	4	5	6	7	8	9	10
BLOCK DESCRIPTION AND MAPPING	8									
MARK BREEDING BIRD AND FURBEARER TRANSECTS	20			8		8			8	
SURVEY BREEDING BIRDS		42		42			42			42
VEGETATION SAMPLING		15		15			15			15
MARK SAMPLE SNAGS	6					2			2	
SAMPLE SNAG ATTRIBUTES AND USE	24		26			26			26	
SURVEY WINTER FURBEARERS	32		32			32			32	
TOTAL FIELD MANDAYS	**90**	**57**	**58**	**65**		**68**	**57**		**68**	**57**
REPORTING (CONTRACT)	25	15	20	15		20	15		20	15
REPORTING (WILLISTON WILDLIFE STAFF)	10	6	6	6	10	6				15
TOTAL PROJECT MANDAYS	**125**	**78**	**84**	**86**	**10**	**94**	**72**	**0**	**88**	**87**

coefficient of detectability, or C.D. (Emlen 1971) will be calculated for each species. According to Emlen (1971) the C.D. depends on the distance of the birds from the transect and on the detectability of the birds themselves. To aid distance estimations, markers at distances of 25, 50 and 75 metres will be set up when the transects are established. This sampling will allow relative density to be calculated for each species or species group and will allow each bird location to be mapped.

Approximately 1.5 kilometres of transect will be flagged for each 25 hectares of treatment area. Each treatment and control area will be surveyed in its entirety. Birds will be recorded in 10 metre increments out to 50 metres and then any other birds between 50 and 75 metres would be recorded. If possible a whole block will be surveyed in the same day to ensure relative uniformity of conditions at the time of survey for all treatments within a block.

d) Furbearers

Winter use by marten and other small mammals will be sampled using the same transects established for breeding birds. Each track crossing the transect line will be identified and its location recorded on 50 metre segments along the transect. The transects will be surveyed 3-5 times over the winter. If possible, the transects will be surveyed 2-3 days after a fresh snowfall.

If the track density is very low, this method will not provide a good evaluation of the treatments. In this case, a trailing method (Simpson and Woods 1987) will be used to describe the relative habitat use by marten in treatment and control blocks and to describe other micro-habitat characteristics. Using this method, the observer locates and follows a marten trail in the trial blocks recording the distance travelled in treatment units and/or other predetermined habitat types. Plots would also be established at set intervals to record micro-habitat variables of interest. The same variables would then measured in randomly located transects within the same habitat type to compare micro-habitats used by the animal to those available in the same habitat. Variables considered for measurement would include: snow depth, snow density, slash attributes and volume, distance to forest edge and distance to green tree retention clumps. Details of the methodology will be developed if this method is to be used.

e) Snag Deterioration and Cavity Nester Use

After logging, all of the stubs in one block (approx. 500) and all of the trees, dead or alive, in four of the green tree retention islands (two in each of the treatments containing islands) will be marked with numbered permanent tags and entered on a map. The marked snags will be periodically re-examined as outlined in the previous sampling schedule in Table 2. Data collection for monitoring snag decay and wildlife use of snags will follow the guidelines set out in the "Wildlife/Danger Tree Field Assessment Data Cards" (Appendix 3), designed by the Wildlife Tree Committee of British Columbia, in conjunction with the Wildlife/Danger Tree Assessors Course (Wildlife Tree Committee, 1992). Attributes sampled on the data forms will include species (a), site position (b), D.B.H. (c), height (d), decay stage (e), heartwood condition (g), top condition (i), and cause of death (m).

Data forms were revised for this project to reflect additional data that will be collected including % bark remaining and whether a tree has been windthown or subjected to bark beetle attack (Appendix 4). Data collected on the use of trees by wildlife species will also be more detailed than that noted on the Wildlife Tree Committee's data forms. When a cavity is located, an attempt will

be made to determine whether it is an active nesting cavity. Because primary cavity nesters excavate fresh nest cavities each spring (Keisker, 1987), the ground around each snag will be examined for the presence of wood chips. If wood chips are present, their relation with respect to the previous season's leaf litter will aid in determining whether the cavity was excavated in the current season. If the cavity appears to be fresh, field personnel will try to confirm active nesting cavities by observing adults entering or leaving the cavity or by listening for young calling from the nest. Secondary cavity nesters do not excavate their own cavities, so identifying cavities as possible candidates for nests may be more difficult. All cavities will be watched closely for signs of activity.

Each cavity will be classified as an active nesting cavity, an old unoccupied cavity or a cavity start (incompletely excavated). Where active nests are confirmed, diameter of the cavity entrance, height of the cavity above the ground, snag diameter at hole height, type of cavity (excavated or natural), compass orientation of the cavity, condition of wood containing the cavity (if possible), and occupying species will be recorded for each cavity. If the cavity is old, the suspected excavator will be recorded. Open nests will be classified as active/inactive; the species nesting and the nest position in the tree will also be recorded.

The following information will be noted for feeding sign: location (top/bottom/throughout), degree of use (minimal/extensive), and species using tree if known will be recorded. The location of feeding sign recorded in subsequent samplings will be compared with previous samplings in order to identify new feeding sign. Bird species perching on wildlife trees will also be recorded, as will signs of other wildlife use including porcupine chewing, squirrel dens/caches, marten dens etc.

3. DATA ANALYSIS

a) Vegetation Description

The vegetation data will be summarized for each year of data collection as follows:

a) bar graphs of average % cover by vegetation layer for each block and treatment unit (ie. 15 graphs total) and for all blocks and treatments combined.
b) tabulation of "dominant species" by layer as shown in Appendix 5. "Dominant species" will include the species in each layer with the highest percent cover as well as all other species which have a cover value of 25 % or more.

b) Use of Treatments by Breeding Birds

Table 3 shows how the analysis of each year's breeding bird data will be done using an analysis of variance (ANOVA). If treatment is found to be a significant factor, Duncan's multiple range test will be used to show which treatments are significantly different from each other.

After year 10, the data from all years will be pooled and analyzed using a repeated measures design. Measures of vegetation development and snag decay may be able to be used as covariates.

These analyses will be performed for each of the following response variables:

- total bird density
- density of non-cavity nesting passerine birds
- density of cavity nesting birds
- density of each of the five most abundant bird species

Table 3. ANOVA table for the analysis of breeding bird data.

SOURCE OF VARIATION	DEGREES OF FREEDOM
BLOCKS(B)	2
TREATMENT(T)	4
SAMPLING PERIOD(S)	4
BxT	8
BxS	8
TxS	16
BxTxS	32
TOTAL	74

The relationship of bird density to distance from forest edge and distance from green tree retention clumps will be analyzed by simple regression and visual graphical techniques. Block maps which show both habitat information and bird locations will be visually inspected for patterns and trends. Statistical analyses of interesting patterns could be done using simple regression and/or Chi square tests to analyze use compared to availability.

c) Use of Treatments by Furbearers

Track transect data for marten and other furbearers will be analyzed using the same ANOVA design as for breeding birds. The response variable will the average number of tracks per kilometre per week. If trailing is used, treatment and micro-habitat preferences will be tested using chi-square tests to compare use to availability.

d) Snag Deterioration Rate

Each year's data will be keypunched into a SAS data file. A table (Appendix 6) summarizing snag numbers by species, diameter and decay classes will be produced for each sampling year. The first major analysis of this data will be done after ten years. Differences in the change in decay class over time will be tested between different species and between different diameter classes within species. Blowdown rate and beetle attack will also be analyzed by species and diameter classes. Tests will be carried out using Chi square methods.

e) Snag Selection for Feeding and Nesting

The use of various types of snags will be tested for feeding and nesting abundance against the use expected based on random selection within the whole group of sampled snags, using Chi square tests. The following factors will be used to classify snag type for these analyses: species, height, dbh, decay class, distance to edge of clearcut, and distance to the edge of the nearest green tree retention clump. Separate analyses will be done for the short snags and for trees and snags within the retention clumps.

Frequency diagrams of cavity height, orientation, snag species, dbh and decay classes will be produced for each of the cavity nester species found and for all of the species combined.

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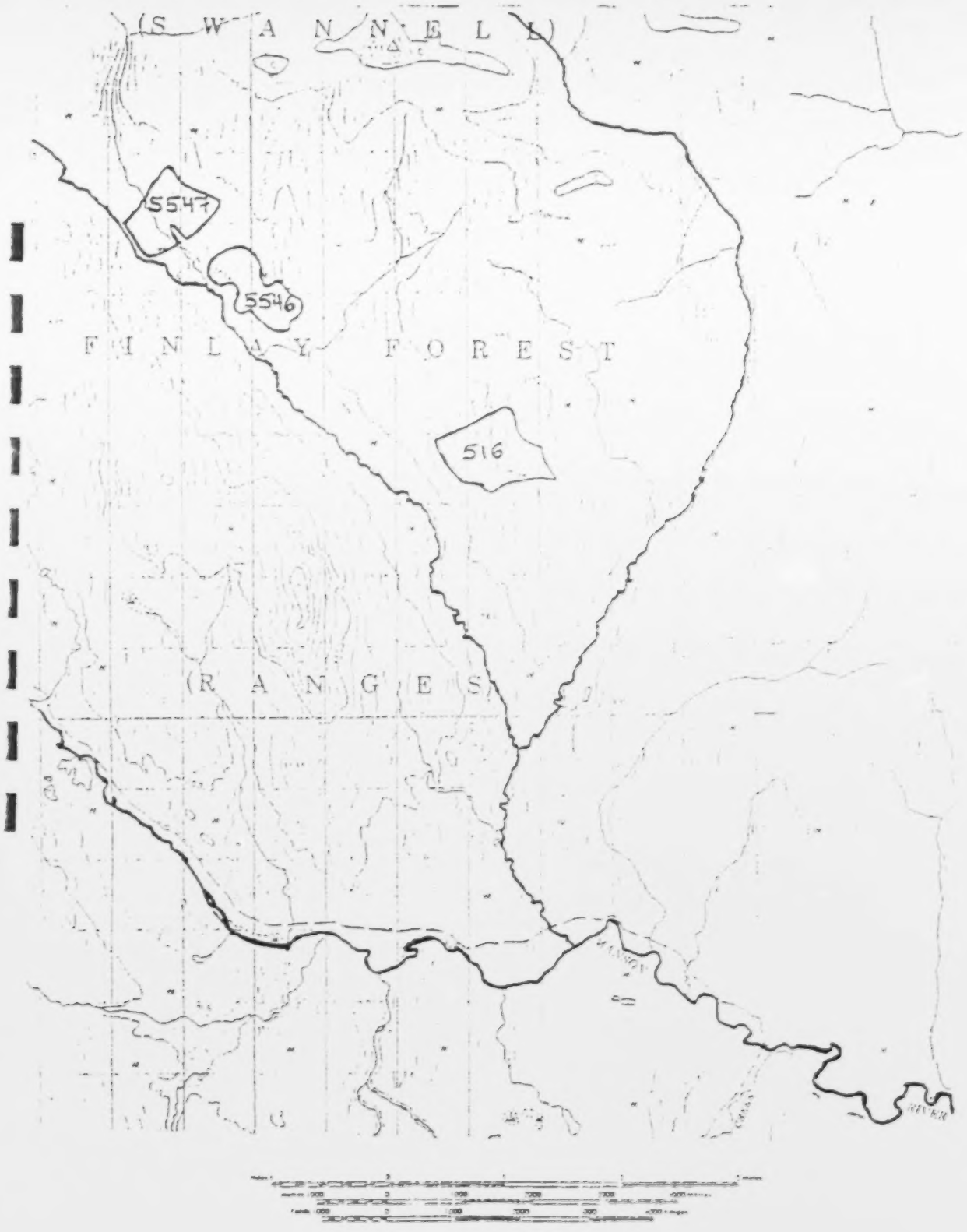
APPENDIX I. Maps of study blocks.

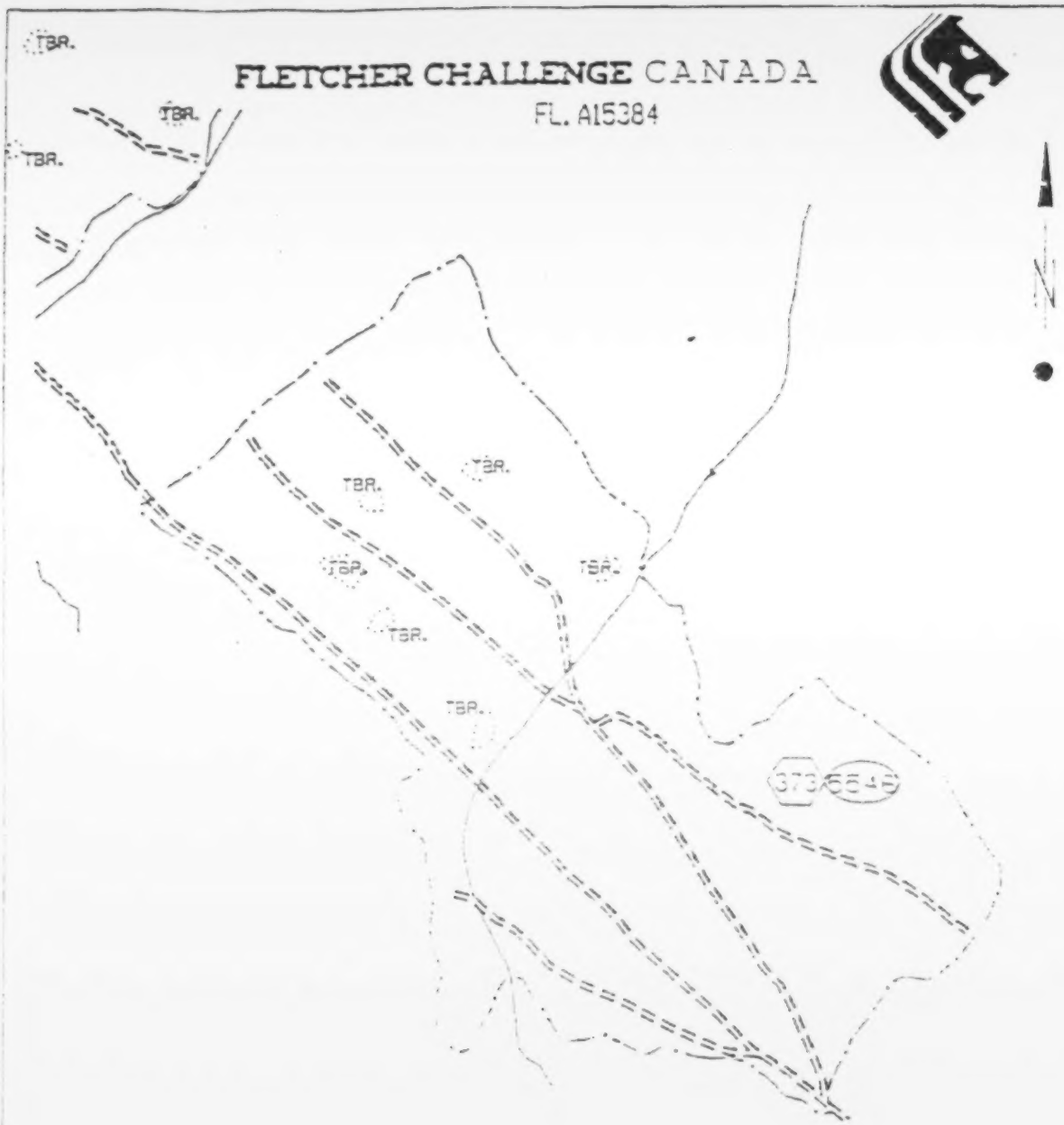


371-516

(Proposed Boundary)

FLETCHER CHALLENGE CANADA

FL. A15384



Total Area	98.6 ha.
Roads & Landings	5.8 ha.
TBR.	[illegible] ha.
Net Area	- [illegible] ha.

GPS Survey - 3D differentially corrected.
Date : November 28, 1991
GPS Accuracies do not apply to untraversed features.

Timber Mark _____

SCALE: 1:10,000

TREATMENT

C.P. 373 BLK. **5546**

FLETCHER CHALLENGE CANADA

FL. A15384

Total Area	111.3 ha
Roads & Landings	4.7 ha
[illegible]	[illegible]
Net Area	86.8 ha

GPS Survey - 3D differentially corrected.
Date : November 28, 1991
GPS Accuracies do not apply to untraversed features.

Timber Mark _____

SCALE: 1:10,000

TREATMENT

C.P. 373 BLK. **5547**

APPENDIX 2: Discussion of alternate sampling methods for sampling breeding birds.

Breeding birds are most often sampled using point counts, spot (territory) mapping or transect counts. Each of these methods will be described briefly, their suitability examined for our purposes, and an estimate given for the time and manpower required.

Point Counts:

Point Counts can be used to provide an estimate of the relative abundance (number of detections per sample point) of bird species. Stations (points) are set up along transects or are scattered through the study area. An observer remains stationary at each of these points while recording every bird seen or heard around the station for a predetermined length of time. The distance from the observer to where each bird was first detected is noted. The length of time spent counting at each station and the radius in which the birds are sampled will vary depending on the habitat.

Dr Savard (pers. comm.) suggests that a minimum of 6 stations would be required for each 20 hectares, and that each station should be surveyed at least 3 or 4 times throughout the breeding season. It was suggested that the duration of the count be 12 minutes, and that the radius be 100 meters.

Based on the preceding information, each block would require a minimum of 19 (64 hectare block) to 40 (134 hectare block) stations. If each station was surveyed for 12 minutes, one observer could perhaps do one point each half hour, allowing travel time between stations, a "rest period" (Reynolds et al. 1980) to allow bird activity to return to normal after the observers arrival at the station, and time to make any other notes after each survey. The birds can only be surveyed for a few hours after dawn before singing diminishes or weather conditions intervene, so an observer may only be able to survey 8 to 10 stations during one day under ideal conditions. At such a rate, it would take one observer 2 - 5 days to survey one block once. Using this method would probably require 3 observers in order to survey all 6 blocks 3 or 4 times over a 6 to 8 week period.

Because this method relies heavily on song cues, highly skilled observers are required. The effects of missing birds can seriously bias the results as can errors in identification (Verner 1985). Accurate distance estimations are very important since this method depends on accurately being able to determine the distance from the station where the number of birds observed begins to decline in a particular habitat (Reynolds et al. 1980). It is extremely difficult to be precise with distance estimations of singing birds at 100 meters. A small discrepancy in the distance estimate can result in a substantial bias in abundance. As well, and very important since we are interested in cavity nesters is that the relatively short distances of radii make it a poor method for large territory birds like woodpeckers (Savard, pers. comm.).

Spot Mapping:

Spot (territory) mapping provides an estimate of the number of breeding pairs of territorial, non-colonial species on a given plot. It can be used to estimate population densities and to examine species composition and relative abundance of bird communities (Robbins 1970). Spot mapping involves surveying an established plot and mapping the locations of every bird

seen or heard onto a gridded map. Each time the plot is surveyed, the information is transferred onto separate maps for each species. Eventually clusters of activity can be identified on the species maps which is assumed to represent individual territory holders allowing the determination of the number of territorial males on the plot. A grid system for the marking the plot must be established prior to censusing the block unless physical features allow the observer to know his own position and that of every bird recorded anywhere on the block. The same grid co-ordinates are used on the map sheets to enable accurate placements of birds located on the plot.

For our purposes, Dr. Savard (pers, comm.) recommends that each plot encompass an entire treatment since cavity nesters such as woodpeckers have relatively large territories. A large plot size is also recommended by Robbins (1970). Each plot should be surveyed at least 8 times during the course of the breeding season in an open habitat (Robbins 1970). More surveys are required in a closed habitat.

Assuming one plot represents an entire treatment area or control, each study area will have 12 plots. An observer could possibly survey 1 or 2 plots per day under ideal conditions, so 6 to 12 days will be required to survey all plots in one study area once. This method would probably take 3 observers at least 8 weeks to survey all 24 plots 8 times.

Although observers must be skilled, there is some leeway for them to seek out an unknown song, or track down an odd looking bird as long as it doesn't take an extended period of time. This is possible because the observer does not have to walk a set route. The observer must cover the entire plot as evenly as possible, but the route should vary from day to day. This method is most effective for species that produce frequent song cues within territories that are small relative to the plot size. Because woodpeckers tend to have larger territories and may be quieter than most passerines, this method may not be the most suitable for our purposes.

Line Transects:

Transect counts are another frequently used survey method for determining estimates of population densities in non-colonial land birds. There are several variations of transect counts, but they basically involve an observer walking along a census route (transect) while recording all birds seen or heard out to a certain perpendicular distance from the transect. The estimate of the perpendicular distance from the transect to the bird at it's first point of detection is very important in this method. After the transects have been surveyed a number of times, a coefficient of detectability, or C.D. (Emlen 1971) is calculated for each species. According to Emlen (1971) the C.D. depends onthe distance of the birds from the transect and on the detectability of the birds themselves. To aid distance estimations, markers or a grid system can be set up when the transects are established.

For our purposes, Dr. Savard (pers, comm.) suggests that there be approximately 1.5 km of transect for each 25 ha surveyed. Each treatment area and control should be surveyed in its entirety. Birds would be recorded in increments out to 50 meters and then any other birds between 50 and 75 meters would be recorded. The transect lines would then be 150 meters apart. Each transect should be surveyed at least 5 times during the breeding season. Because observers would alternate between quiet walking and brief stops to look, listen and manoeuvre, net speeds would probably average 1 to 2 km per hour. At this pace, 4 to 8 km of transect could be surveyed each day under ideal conditions. It may then be possible to survey an entire 100 ha block in 1 day or at least all three blocks in one study area could be surveyed once in

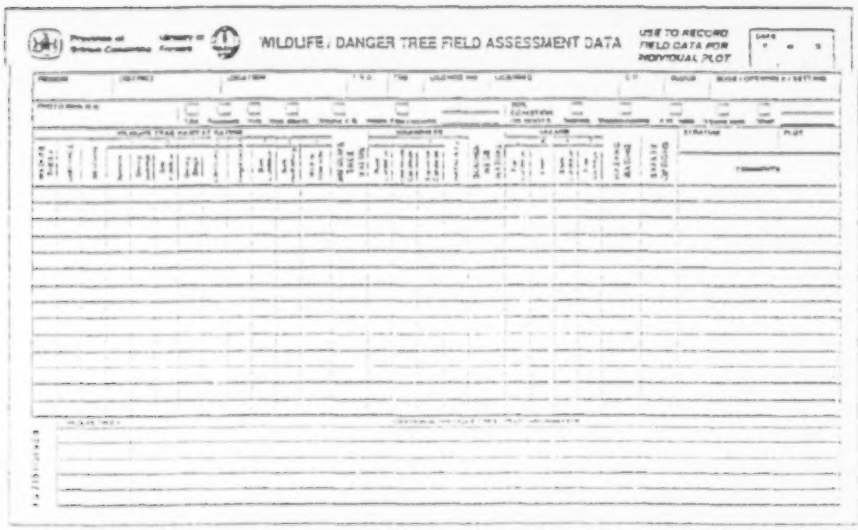
3 to 5 days. This method would probably require one observer 6 to 7 weeks or 2 observers 3 to 4 weeks to survey each transect 5 times. If 2 field personnel began marking transects and the corresponding grid system (with stakes) in early May, surveying could begin by about the third week in May. Having the observers working in the blocks prior to surveying would also allow them to familiarize themselves with the blocks, the birds and have a better idea of when surveying should begin based on the local activity.

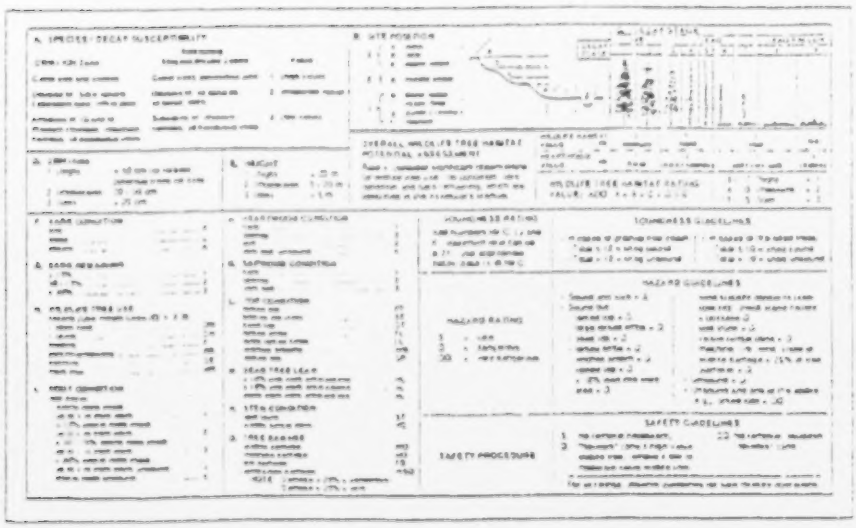
This method requires highly skilled observers, although the observer can leave the line briefly to seek out unfamiliar songs or perhaps "squeak" and "pish" to lure a hidden bird into view as long as the bird is recorded at the point of detection rather than the point of identification. The transect method is efficient and offers flexibility because the birds do not need to be territorial, allowing the method to be used outside of the breeding season.

Winter Bird Use:

If desired, winter bird use can be recorded using the line transect methodology. Winter bird data could be collected at the same time as data is collected for winter moose/marten use.

APPENDIX 3: Wildlife/Danger Tree Field Assessment Data Cards





WILDLIFE TREE ASSESSMENT FORM

BLOCK: **TREATMENT UNIT:**

WILDLIFE TREE #: **DATE:**

LIVE_____ DEAD_____ **ASSESSORS:**

A. *SPECIES*_____

B. SITE POSITION A B C D E F G

C. DBH (cm)_____ 1(>50) 2(20-50) 3(<50)

D. HEIGHT (m)_____ 1(>20) 2(5-20) 3(<5)

E. DECAY STAGE 1 2 3 4 5 6 7 8 9

Comments:_____

_____

_____

H. CAUSE OF DEATH MT F I D SU NA FB

Comments:_____

_____

_____

I. TOP CONDITION FT FL WB +L -L BC LC ST CUT

Comments:_____

J. BARK REMAINING (%) <50 50-75 >75

Comments:_____

_____

K. WILDLIFE TREE USE

Cavity Nests: Size (cm)	Ht. from ground (m)	Active/Inactive (species)
_____	_____	_____
_____	_____	_____
_____	_____	_____

Open Nests: Yes No Active: Yes No

Species nesting: _____

Feeding: Yes No

Type of feeding: _____

Perching: Yes No

Species observed: _____

Other Wildife Use: _____

_____

_____

J. OTHER OBSERVATIONS

_____

_____

_____

_____

APPENDIX 5. Summary table of dominant species.

		Dominant species and % cover in each layer					
Block	Treat.	moss	low herb	tall herb	low shrub	tall shrub	
1	1						
	2						
	3						
	4						
2	1						
	2						
	3						
	4						
3	1						
	2						
	3						
	4						
All combined							

APPENDIX 6. Summary table of snag numbers by species, diameter and decay classes.

SPECIES	DIAMETER CLASS	DECAY CLASS	NUMBER OF SNAGS
Engelmann spruce	15-25	1	
		2	
		3	
		4	
		5	
	26-35	1	
		2	
		3	
		4	
		5	
	36-45	1	
		2	
		3	
		4	
		5	
	46+	1	
		2	
		3	
		4	
		5	
OTHER SPECIES	15-15	1	
		2	
		3	